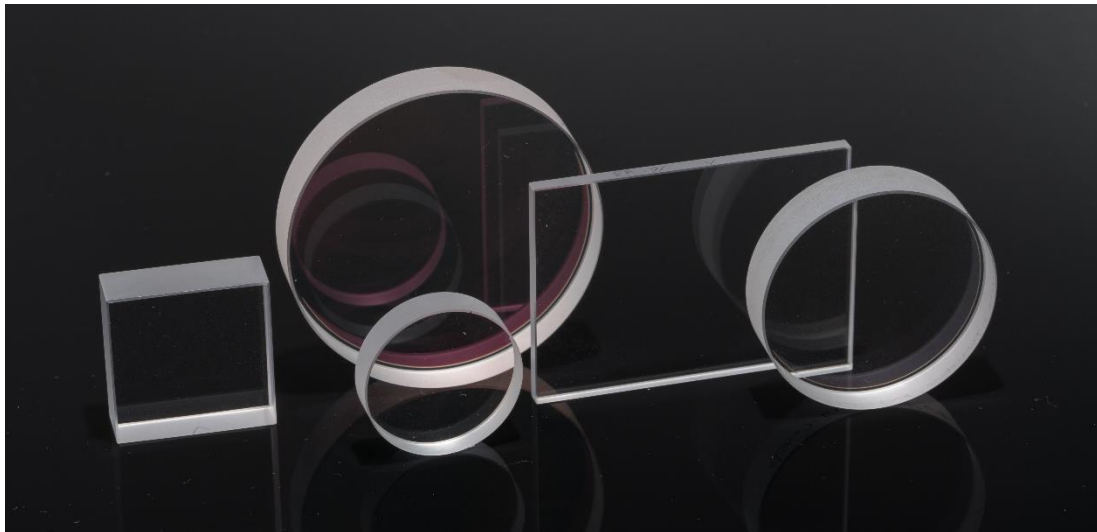


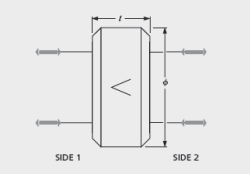
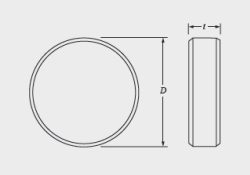
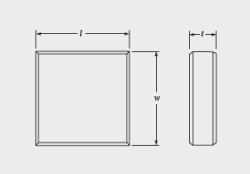
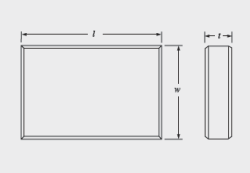
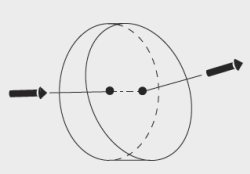
# WINDOWS & OPTICAL FLATS

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한국전광은 폭넓은 광 산업분야에 활용되는 광학용 윈도우를 제조 및 공급합니다. 특정 광학 환경을 다른 환경과 분리하거나, 빔을 샘플링, 분할 또는 조정해야 하는 경우 당사는 사용자 요구 사항을 충족하는 윈도우를 제공합니다. 당사의 윈도우는 무반사 코팅, 모양 및 wedge 옵션과 관련하여 높은 레이저 손상 임계값을 가진 광범위한 선택을 제공함으로써 사용자 필요한 정확한 광학 성능을 구현합니다.

SELECTION GUIDE

Product Type	Description
<p><b>ANTIREFLECTION COATED WINDOWS</b></p> 	<p>Antireflection coated parallel windows feature low distortion, low scatter and excellent parallelism. A surface flatness of <math>\lambda/10</math> and scratch-dig of 10-5 offer high beam control for demanding laser applications.</p>
<p><b>PLANE PARALLEL LASER GRADE WINDOWS</b></p> 	<p>PW1 windows are polished on two sides, with a wedge of <math>\leq 10</math> arc seconds, and are manufactured to handle high power applications. They form the foundation for several coated products, such as W1, W2, beamsplitters, output couplers, harmonic separators, dichroic mirrors, and partial reflectors.</p>
<p><b>SQUARE WINDOWS</b></p> 	<p>SQW series square windows are designed for a wide variety of laser window and beamsplitting applications. Typical transmitted wavefront error is less than <math>\lambda/10</math> peak-to-valley @ 633 nm over 85% of the window's dimension.</p>
<p><b>RECTANGULAR WINDOWS</b></p> 	<p>RW series rectangular windows are designed for a wide variety of laser window and beamsplitting applications. Typical transmitted wavefront error is less than <math>\lambda/10</math> peak-to-valley @ 633 nm over 85% of the window's dimension.</p>
<p><b>WEDGE WINDOWS</b></p> 	<p>Wedge windows or prisms deviate an incident beam at a precise angle. Two wedge prisms of equal power can be combined to create a beam-steering apparatus that can place a beam anywhere within a cone defined by the deviation angle.</p>

## ANTIREFLECTION COATED LASER WINDOWS



### Specifications

**Product Code**

W1, W2

**Antireflection Coating Single wavelength:**

- R ≤ 0.25% per surface @ 0°
- R ≤ 0.75% per surface @ 45°S
- R ≤ 1.30% per surface @ 45°S
- R ≤ 0.25% per surface @ 45°P

**Antireflection Coating Broadband AR:**

- R<sub>avg</sub> ≤ 0.50% per surface @ 0°
- R ≤ 1.50% per surface @ 45°UNP
- R ≤ 3.0% per surface @ 45°S
- R ≤ 0.50% per surface @ 45°P

**Antireflection Coating Dual wavelength:**

- R ≤ 0.30% at 1064 nm @ 0°
- R ≤ 0.60% at 532 nm @ 0°

**Coating Technology:**

Electron Beam Multilayer Dielectric

**Adhesion and Durability:**

Per MIL-C-675C. Insoluble in lab solvents.

**Clear Aperture:**

≥85% of central diameter

**Angle of Incidence:**

User specified

**Damage Threshold Pulsed:**

- Single wavelength: 15 J/cm<sup>2</sup>, 20 nsec, 20 Hz @ 1064 nm
- Broadband: 10 J/cm<sup>2</sup>, 20 nsec, 20 Hz @ 1064 nm
- Dual wavelength: 5 J/cm<sup>2</sup>, 20 nsec, 20 Hz @ 532 nm, 10 J/cm<sup>2</sup>, 20 nsec, 20 Hz @ 1064 nm

**Damage Threshold Continuous Wave:**

1 MW/cm<sup>2</sup> @ 1064 nm

**Optical Material:**

UV-grade fused silica

**Transmitted Wavefront Error:**

λ/10 @ 633 nm

**Surface Quality:**

10-5 scratch and dig

**Diameter:**

∅+0/-0.25 mm

**Thickness:**

t±0.25 mm

**Wedge:**

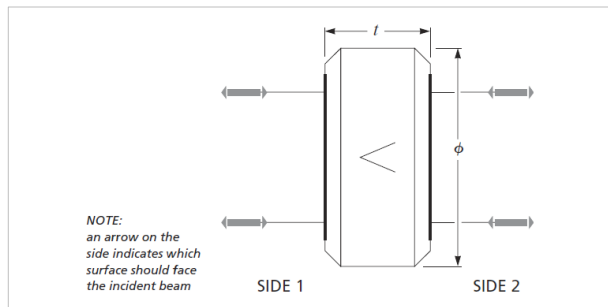
≤ 10 arc sec or 30±5 arc min

**Chamfer:**

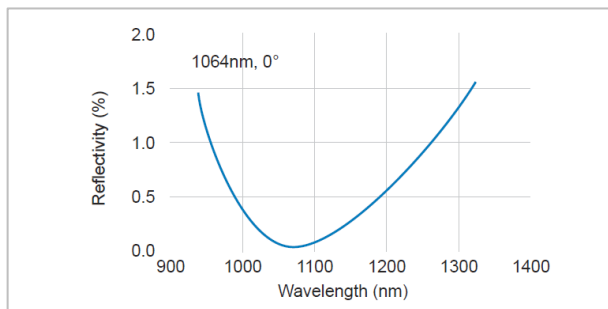
- ∅ ≤ 50.8 mm: 0.35 mm @ 45°
- ∅ > 50.8 mm: 0.85 mm @ 45°

반사 방지 코팅의 윈도우는 UV Fused Silica로 제조되며 왜곡 현상을 줄여 분산 효과를 감소시키고 평행성이 우수합니다. 표면 평탄도 λ/10 및 스크래치 디그 10-5는 고출력 레이저에서 발생하는 분산 효과를 줄이고 뛰어난 빔 제어를 제공합니다.

- ◆ 샘플 셀 및 진공 챔버 윈도우
- ◆ 하이 게인 레이저를 위한 출력 커플러
- ◆ 주문 제작, 저손실, 높은 손상 임계값 AR 코팅, 파장 또는 기판 옵션에 대한 사용 가능 여부는 당사 판매 그룹에 문의하십시오.



Antireflection Coated Windows



Reflectivity vs. wavelength of 1064 nm V-type AR coating

● Standard Products

Wavelength or Wavelength Range (nm)	Reflectance per coated surface (%)	Optimized Angle of Incidence (degrees)	∅ (mm)	t (mm)	Wedge α	
<b>Antireflection Coated Windows, Laser Line (Both Surfaces Coated)</b>						
193.0	R≤0.25%	0°	25.4	6.35	≤10 arc sec	
248.0	R≤0.25%	0°	25.4	6.35	≤10 arc sec	
266.0	R≤0.25%	0°	25.4	6.35	≤10 arc sec	
355.0	R≤0.25%	0°	25.4	6.35	≤10 arc sec	
532.0	R≤0.25%	0°	25.4	6.35	≤10 arc sec	
633.0	R≤0.25%	0°	25.4	6.35	≤10 arc sec	
800.0	R≤0.25%	0°	25.4	3.175	≤10 arc sec	
800.0	R≤0.25%	0°	50.8	6.35	≤10 arc sec	
1030.0	R≤0.25%	0°	25.4	6.35	≤10 arc sec	
1064.0	R≤0.25%	0°	12.7	6.35	≤10 arc sec	
1064.0	R≤0.25%	0°	25.4	6.35	≤10 arc sec	
1064.0	R≤0.25%	0°	50.8	6.35	≤10 arc sec	
1064.0 & 532.0	R≤0.30% at 1064 nm and R≤0.60% at 532 nm	0°	25.4	6.35	≤10 arc sec	
1550.0	R≤0.25%	0°	25.4	6.35	≤10 arc sec	
<b>Antireflection Coated Wedge Windows, Laser Line (Both Surfaces Coated)</b>						
266.0	R≤0.25%	0°	25.4	6.35	30±5 arc min	
355.0	R≤0.25%	0°	25.4	6.35	30±5 arc min	
532.0	R≤0.25%	0°	25.4	6.35	30±5 arc min	
633.0	R≤0.25%	0°	25.4	6.35	30±5 arc min	
1030.0	R≤0.25%	0°	25.4	6.35	30±5 arc min	
1064.0	R≤0.25%	0°	25.4	6.35	30±5 arc min	
<b>Antireflection Coated Wedge Windows, Broadband (Both Surfaces Coated)</b>						
248.0 – 355.0	R <sub>avg</sub> ≤0.50%, R <sub>abs</sub> ≤1.0%	0°	25.4	6.35	30±5 arc min	
355.0 – 532.0	R <sub>avg</sub> ≤0.50%, R <sub>abs</sub> ≤1.0%	0°	25.4	6.35	30±5 arc min	
415.0 – 700.0	R <sub>avg</sub> ≤0.50%, R <sub>abs</sub> ≤1.0%	0°	25.4	6.35	30±5 arc min	
633.0 – 1064.0	R <sub>avg</sub> ≤0.50%, R <sub>abs</sub> ≤1.0%	0°	25.4	6.35	30±5 arc min	
700.0 – 900.0	R <sub>avg</sub> ≤0.25%, R <sub>abs</sub> ≤0.50%	0°	25.4	6.35	30±5 arc min	
1050.0 – 1600.0	R <sub>avg</sub> ≤0.50%, R <sub>abs</sub> ≤1.0%	0°	25.4	6.35	30±5 arc min	
<b>Antireflection Coated Windows, Broadband (Both Surfaces Coated)</b>						
248.0 – 355.0	R <sub>avg</sub> ≤0.50%, R <sub>abs</sub> ≤1.0%	0°	25.4	6.35	≤10 arc sec	
355.0 – 532.0	R <sub>avg</sub> ≤0.50%, R <sub>abs</sub> ≤1.0%	0°	25.4	6.35	≤10 arc sec	
415.0 – 700.0	R <sub>avg</sub> ≤0.50%, R <sub>abs</sub> ≤1.0%	0°	25.4	6.35	≤10 arc sec	
633.0 – 1064.0	R <sub>avg</sub> ≤0.50%, R <sub>abs</sub> ≤1.0%	0°	25.4	6.35	≤10 arc sec	
700.0 – 900.0	R <sub>avg</sub> ≤0.25%, R <sub>abs</sub> ≤0.50%	0°	25.4	6.35	≤10 arc sec	
1050.0 – 1600.0	R <sub>avg</sub> ≤0.50%, R <sub>abs</sub> ≤1.0%	0°	25.4	6.35	≤10 arc sec	

**PRODUCT CODE**

<b>W1</b>	Window, one surface AR coated *
<b>W2</b>	Window, two surfaces AR coated

**WEDGE**

<b>PW1</b>	<10 arc seconds
<b>IF</b>	30 arc minutes±5 arc minutes

**SIZE CODE                      DIAMETER (mm)                      THICKNESS (mm)                      STANDARD OPTIONS**

<b>0512</b>	12.7	3.175	Flat and Wedge
<b>0525</b>	12.7	6.35	Flat and Wedge
<b>0725</b>	19.05	6.35	Flat and Wedge
<b>2506M</b>	25.0	6.0	Flat only
<b>1004</b>	25.4	1.0	Flat only
<b>1012</b>	25.4	3.175	Flat and Wedge
<b>1025</b>	25.4	6.35	Flat and Wedge
<b>1525</b>	38.1	6.35	Flat and Wedge
<b>5010M</b>	50.0	10.0	Flat only
<b>2025</b>	50.8	6.35	Flat and Wedge
<b>2037</b>	50.8	9.525	Flat and Wedge
<b>3050</b>	76.2	12.7	Flat only
<b>4050</b>	101.6	12.7	Flat only

**SUBSTRATE MATERIAL**

<b>UV</b>	UV grade fused silica
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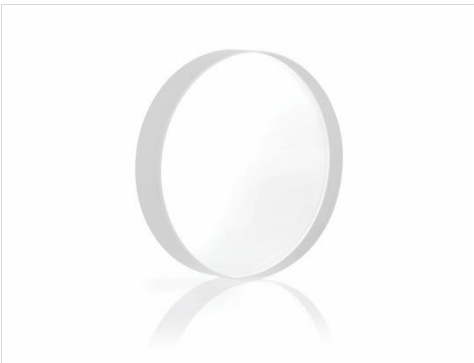
**AR COATING WAVELENGTH nm**

<b>193</b>	<b>355</b>	<b>633</b>	<b>808</b>	<b>1053</b>
<b>248</b>	<b>355-532</b>	<b>633-1064</b>	<b>830</b>	<b>1064</b>
<b>266</b>	<b>415-700</b>	<b>700-900</b>	<b>1030</b>	<b>1064/532</b>
<b>248-355</b>	<b>527</b>	<b>780</b>	<b>1047</b>	<b>1070</b>
<b>351</b>	<b>532</b>	<b>800</b>	<b>1050-1600</b>	<b>1550</b>

**ANGLE OF INCIDENCE IN DEGREES WITH POLARIZATION**

<b>0</b>	Normal incidence
<b>45S</b>	45 degrees s-polarization
<b>45P</b>	45 degrees p-polarization
<b>45UNP</b>	45 degrees Unpolarized

LASER GRADE PLANE PARALLEL WINDOWS,  $\leq 10$  ARC SECONDS



Specifications

**Product Code**  
PW1

**Optical Material**  
UV-grade fused silica or N-BK7 glass

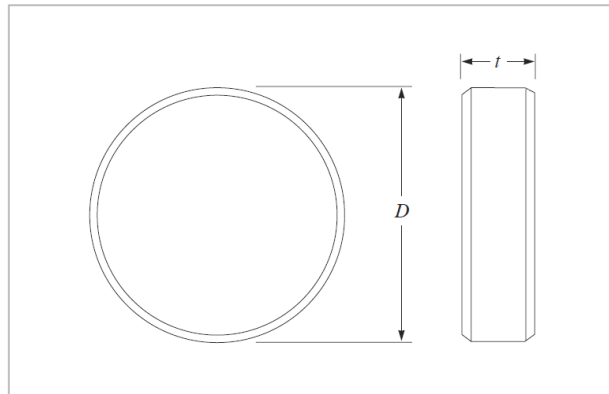
**Diameter**  
 $\varnothing+0/-0.25$  mm

**Thickness**  
 $t\pm 0.25$  mm

**Wedge**  
 $\leq 10$  arc sec

PW1 윈도우는 양쪽 측면이 연마 처리되어 있으며 wedge가  $\leq 10$  각초이고 고출력 분야에 사용하도록 제작되었습니다. 이러한 윈도우는 W1, W2, 빔 분해기, 출력 커플러, 고조파 분해기, 다이크로익 미러 및 부분 반사기와 같이 여러 가지 코팅 제품의 기반이 됩니다.

- ◆ 최상의 평행도
- ◆  $\leq 10$  각초
- ◆ 빔의 최소 각도 편차
- ◆ 윈도우가 반복적으로 장착 및 탈착 시 정렬 오차의 최소



Window dimensions layout

● Standard Products

∅ (mm)	t (mm)	Transmitted Wavefront Error @ 633 nm	Surface Quality	
<b>Laser Grade Windows, ≤10 arc seconds, Fused Silica</b>				
10.0	3.175	λ/10	10-5	
12.7	1.0	λ/4	10-5	
12.7	2.0	λ/10	10-5	
12.7	3.175	λ/10	10-5	
12.7	6.35	λ/10	10-5	
19.1	3.175	λ/10	10-5	
19.1	6.35	λ/10	10-5	
25.0	6.0	λ/10	10-5	
25.4	1.0	λ/10	10-5	
25.4	2.0	λ/10	10-5	
25.4	3.175	λ/10	10-5	
25.4	6.35	λ/10	10-5	
25.4	9.525	λ/10	10-5	
38.1	3.175	λ/10	10-5	
38.1	6.35	λ/10	10-5	
50.0	10.0	λ/10	10-5	
50.8	6.35	λ/10	10-5	
50.8	9.525	λ/10	10-5	
76.2	12.7	λ/10	10-5	
101.6	12.7	λ/10	10-5	
152.4	25.4	λ/10	10-5	
<b>Laser Grade Windows, ≤10 arc seconds, N-BK7</b>				
12.7	3.175	λ/10	10-5	
12.7	6.35	λ/10	10-5	
25.0	6.0	λ/10	10-5	
25.4	3.175	λ/10	10-5	
25.4	6.35	λ/10	10-5	
50.0	10.0	λ/10	10-5	
50.8	6.35	λ/4	10-5	
50.8	9.525	λ/10	10-5	

WINDOWS & OPTICAL FLATS  
 PRISMS & RETROREFLECTORS  
 SPHERICAL LENSES  
 CYLINDRICAL LENSES  
 MULTIELEMENT LENSES  
 MIRRORS  
 BEAMSPLITTERS  
 WAVEPLATES  
 POLARIZATION COMPONENTS  
 ULTRAFAST COMPONENTS  
 FILTERS & ETALONS

## LASER GRADE SQUARE WINDOWS

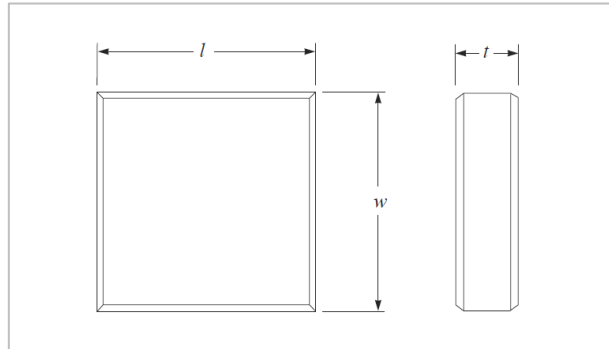


### Specifications

- Product Code**  
SQW
- Optical Material**  
UV-grade fused silica, or N-BK7 glass
- Transmitted Wavefront Error**  
 $\lambda/10$  @ 633 nm
- Surface Quality**  
10-5 scratch and dig
- Dimensional Tolerance**  
 $+0/-0.25$  mm
- Thickness**  
 $t \pm 0.25$  mm
- Wedge**  
 $\leq 5$  arc min
- Clear Aperture**  
 $\geq 85\%$  of central dimension

SQW 시리즈 정사각형 윈도우는 다양한 레이저 윈도우 및 빔 분할 분야를 위해 설계되었습니다. 일반적인 투과 파면 수치는 윈도우 치수의 85%에 대해  $\lambda/10$  p.t.v (peak-to-valley) @ 633nm 미만입니다. 모든 한국전광 이색성 및 금속 코팅이 SQW 시리즈 정사각형 윈도우에 코팅이 가능합니다.

- ◆ 코팅 옵션에 대한 사용 가능 여부는 당사 판매 그룹에게 문의하십시오.



Window dimensions layout

### ● Standard Products

l (mm)	t (mm)	Transmitted Wavefront Error @ 633 nm	
<b>Laser Grade Square Windows, Fused Silica</b>			
12.7	6.4	$\lambda/10$	
25.4	6.4	$\lambda/10$	
50.8	9.5	$\lambda/10$	
<b>Laser Grade Square Windows, N-BK7</b>			
12.7	6.4	$\lambda/10$	
25.4	6.4	$\lambda/4$	



## LASER GRADE RECTANGULAR WINDOWS



### Specifications

**Product Code**

RW

**Optical Material**

UV-grade fused silica, or N-BK7 glass

**Transmitted Wavefront Error**

$\lambda/10$  @ 633 nm

**Surface Quality**

10-5 scratch and dig

**Dimensional Tolerance**

+0/-0.25 mm

**Thickness**

$t \pm 0.25$  mm

**Wedge**

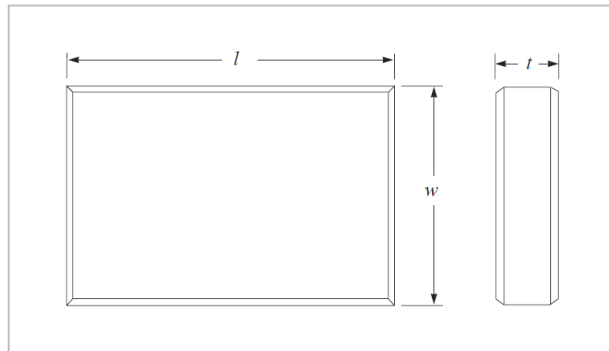
$\leq 5$  arc min

**Clear Aperture**

$\geq 85\%$  of central dimension

RW 시리즈 직사각형 윈도우는 다양한 레이저 윈도우 및 빔 분할 분야를 위해 설계되었습니다. 모든 한국전광 이색성 및 금속 코팅이 RW 시리즈 직사각형 윈도우에 증착될 수 있습니다. 일반적인 투과 파면 오차는 윈도우 치수의 85%에 대해  $\lambda/10$  p.t.v (peak-to-valley) @ 633 nm 미만입니다.

- ◆ 코팅 옵션에 대한 사용 가능 여부는 당사 판매 그룹에게 문의하십시오.



Window dimensions layout

### ● Standard Products

l (mm)	w (mm)	t (mm)	
<b>Fused Silica</b>			
28.6	14.3	3.2	
40.0	30.0	5.0	
<b>N-BK7</b>			
28.6	14.3	3.2	
40.0	30.0	5.0	

## INTERFEROMETER FLATS

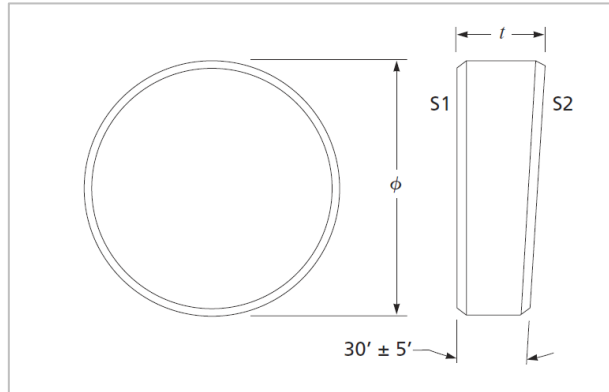


### Specifications

- Product Code**  
IF
- Optical Material**  
UV-grade fused silica, or N-BK7 glass
- Transmitted Wavefront Error**  
 $\lambda/10$  @ 633 nm
- Surface Quality**  
10-5 scratch and dig
- Diameter**  
 $\phi +0/-0.25$  mm
- Thickness**  
 $t \pm 0.25$  mm
- Wedge**  
 $30 \pm 5$  minutes
- Clear Aperture**  
 $\geq 85\%$  of central diameter

IF는 Uncoated 윈도우 기판이고 양쪽이 연마 처리되어 있으며 wedge가  $30 \pm 5$  각분입니다. 따라서 이러한 윈도우는 W1, W2, 빔 분해기, 출력 커플러, 고조파 분해기, Dichroic 미러 및 부분 반사기와 같이 다양한 코팅 제품의 기반이 됩니다.

- ◆ 30분 wedge는 표면 간의 간섭 효과를 최소화합니다.
- ◆ 양쪽 표면에서 반사된 빔을 개별적으로 사용 가능
- ◆ 출력 커플러, 빔 분해기 또는 빔 샘플링 기판
- ◆  $\lambda/10$  투과 파면, 10-5 표면 품질



Interferometer flats have an arrow marked at the thickest edge and points towards side 1 (S1). Side 1 (S1) is at normal incidence and side 2 (S2) is the wedge surface.

### ● Standard Products

$\phi$ (mm)	t (mm)	
<b>Interferometer Flats, Fused Silica</b>		
12.7	3.2	
12.7	6.4	
19.1	6.4	
25.4	3.2	
25.4	6.4	
50.8	6.4	
50.8	9.5	
76.2	12.7	
101.6	12.7	
<b>Interferometer Flats, N-BK7</b>		
12.7	6.4	
25.4	6.4	

## LARGE WEDGE WINDOWS



### Specifications

**Product Code**

LW

**Optical Material**

UV-grade fused silica or N-BK7 glass

**Transmitted Wavefront Error**

$\lambda/10 @ 633 \text{ nm}$

**Surface Quality**

10-5 scratch and dig

**Diameter**

$\phi +0/-0.25 \text{ mm}$

**Thickness**

$t \pm 0.25 \text{ mm}$

**Wedge**

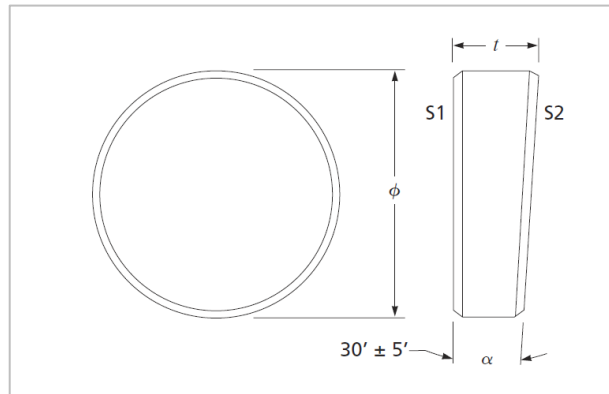
$\pm 6 \text{ minutes}$

**Clear Aperture**

$\geq 85\% \text{ of central diameter}$

Large wedge 윈도우는 wedge 1° 또는 3°로 제작된 레이저 품질 윈도우입니다. 이러한 wedge는 스트레이 광원 방향의 되반사에 의한 간섭을 방지하고 다양한 빔 조정 관련 분야에서 사용됩니다.

- ◆ 모든 한국전광 저손실, 고에너지 AR 코팅 사용 가능
- ◆ OEM 분야를 위해 사용 가능한 기타 치수, wedge 또는 재료 옵션



Large wedge windows have an arrow marked at the thickest edge and points towards side 1 (S1). Side 1 (S1) is at normal incidence and side 2 (S2) is the wedge surface.

### ● Standard Products

$\phi$ (mm)	t (mm)	Wedge $\alpha$	
<b>Large Wedge Windows, Fused Silica</b>			
25.4	9.5	1°	
50.8	9.5	1°	
25.4	9.5	3°	
50.8	9.5	3°	
76.2	12.7	3°	
<b>Large Wedge Windows, N-BK7</b>			
25.4	9.5	1°	
50.8	9.5	1°	
25.4	9.5	3°	
50.8	9.5	3°	

## APPLICATION NOTE

### Using Large Wedge Windows

For small angles of incidence, the deviation of a ray incident on a wedged window with wedge angle  $\alpha$  is

$$\theta_d = \frac{\eta_s}{\eta_a} \alpha$$

The first reflected ray is misaligned from the initial axis by an angle defined by

$$\theta_r = \frac{2\eta_s \alpha}{\eta_a}$$

If  $\eta_a = 1$ , then  $\theta_r = 2\eta_s \alpha$ .

When using a wedge as an output coupling mirror in a laser, usually the front surface is coated with the partially reflecting coating and the second surface with an antireflection coating. In very high gain or very sensitive lasers, it is important to completely misalign the beam coming from the second surface.

Optics can provide mirrors and beamsplitters where  $\alpha$  is between  $0.5^\circ$  (IF Series) and  $3^\circ$  (LW Series) to prevent this stray feedback.

To create an adjustable beamsteering device, use a pair of identically wedged windows (see Figure 2). Any deflection angle from 0 to  $2\theta$ , can be obtained by suitable rotation of the individual wedges. The resulting deflection can be positioned anywhere within a cone centered on the original propagation direction. The direction of deflection is along a plane midway between the rotation angles of the two individual prisms. The magnitude of deflection varies smoothly from the maximum value  $2\theta$  where the thinnest points of the two wedges coincide to zero to when the two wedges are oriented antiparallel, thereby canceling each other.

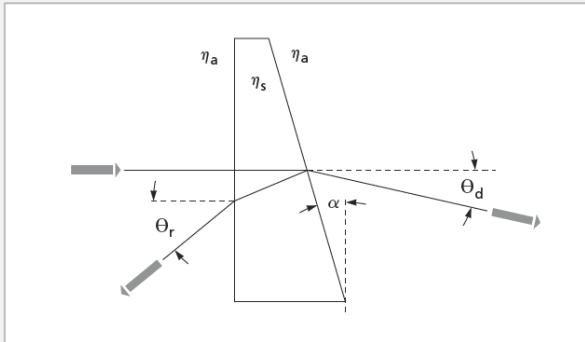


Figure 1. Deviation and reflection of beam by a wedged window of wedge  $\alpha$

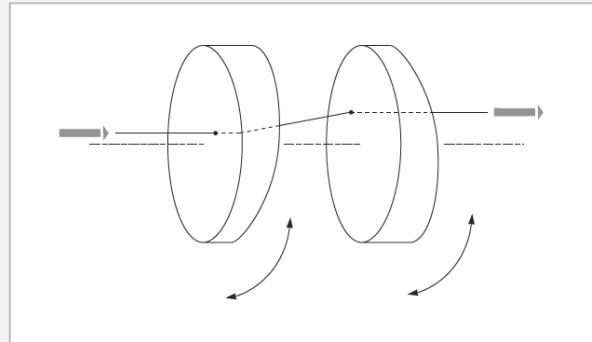


Figure 2. A beamsteering wedge formed from two wedged prisms